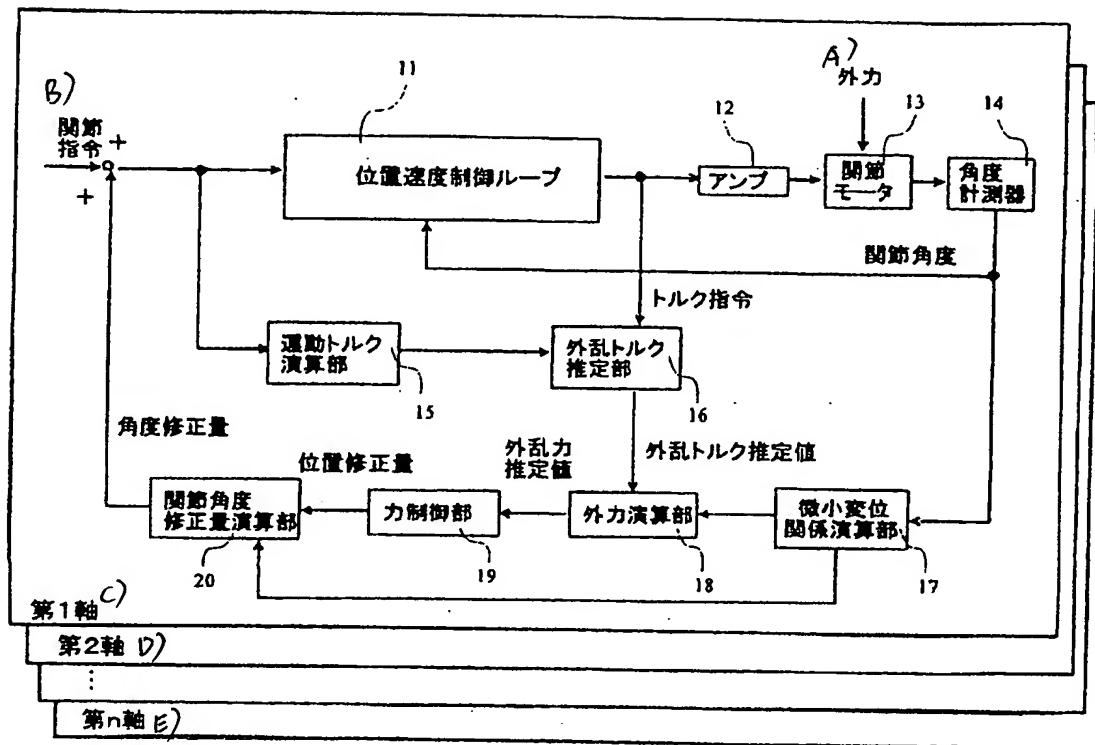


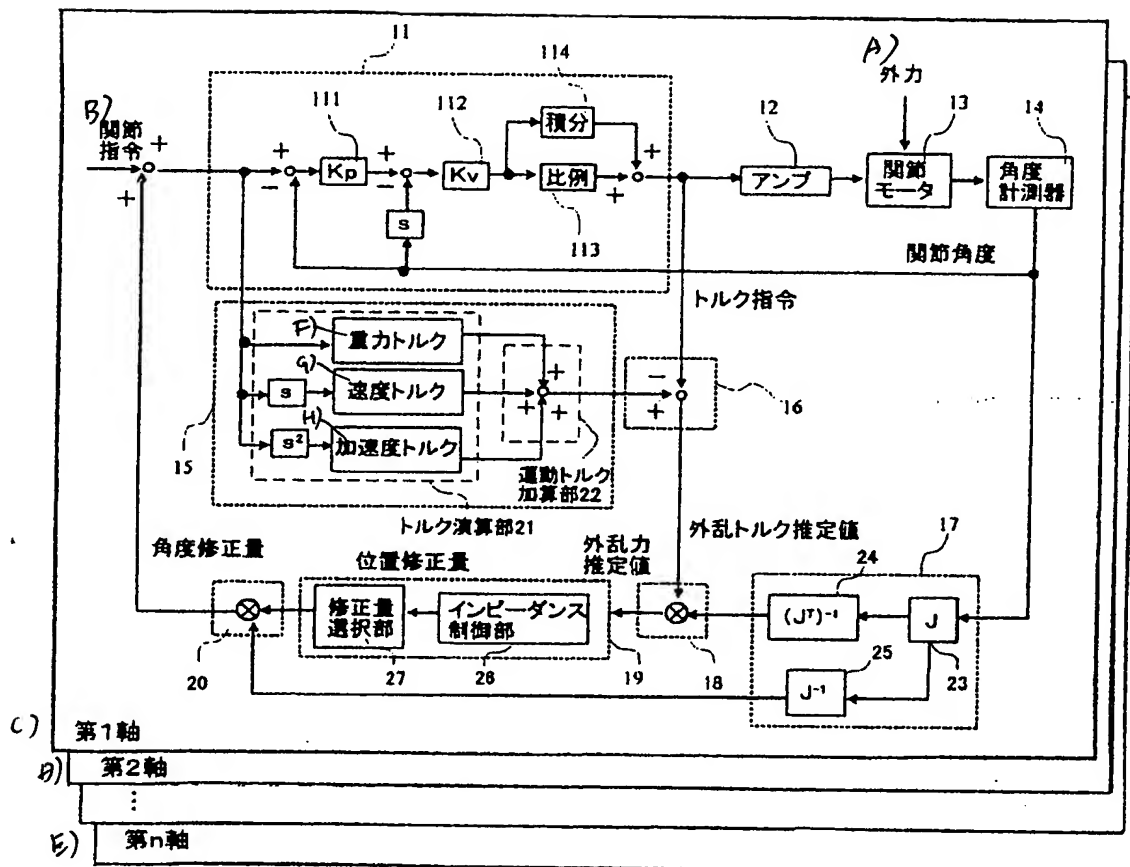
Fig. 1



- A) External Force
- B) Joint Command
- C) First Axis
- D) Second Axis
- E) N-Th Axis

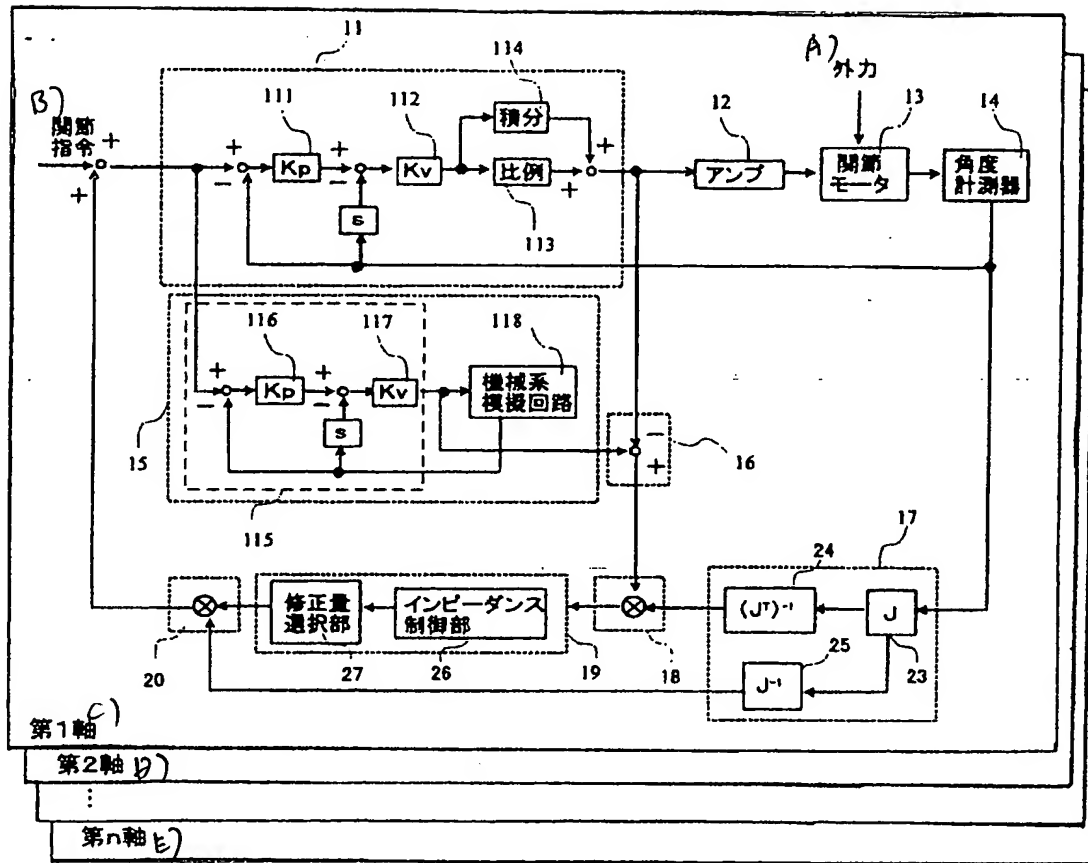
- (11) Position And Speed Control Loop
- (12) Amplifier
- (13) Joint Motor
- (14) Angle Measuring Device
- (15) Motion Torque Calculating Section
- (16) Disturbance Torque Estimating Section
- (17) Minute Displacement Relationship Calculating Section
- (18) External Force Calculating Section
- (19) Force Control Section
- (20) Joint Angle Correction Amount Calculating Section

Fig. 2



- A) External Force
- B) Joint Command
- C) First Axis
- D) Second Axis
- E) N-th Axis
- F) Gravity Torque
- G) Speed Torque
- H) Acceleration Torque
- (12) Amplifier
- (13) Joint Motor
- (14) Angle Measuring Device
- (21) Torque Calculating Section
- (22) Motion Torque Adding Section
- (26) Impedance Control Section
- (27) Correction Amount Selecting Section
- (113) Proportion
- (114) Integration

Fig. 3



- A) External Force
- B) Torque Command
- C) First Axis
- D) Second Axis
- E) N-Th Axis

- (12) Amplifier
- (13) Joint Motor
- (14) Angle Measuring Device
- (26) Impedance Control Section
- (27) Correction Amount Selecting Section
- (113) Proportion
- (114) Integration
- (118) Mechanical System Imitating Circuit

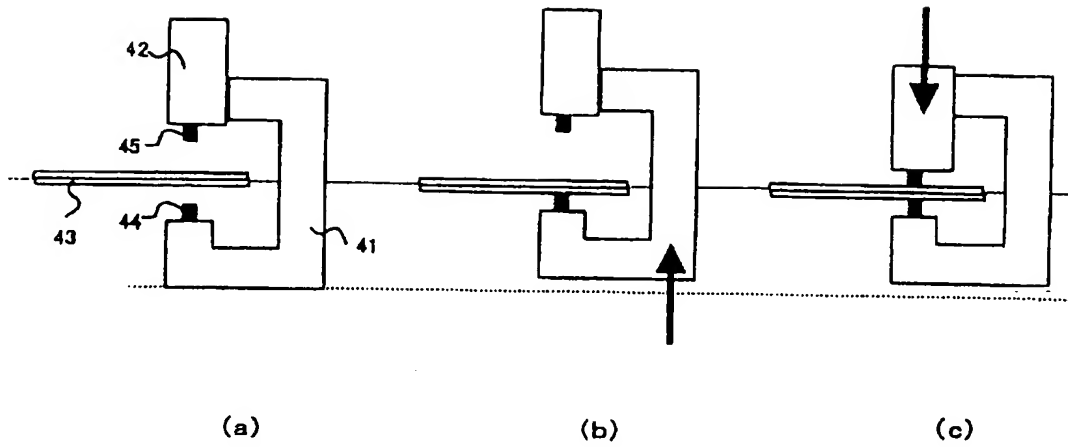
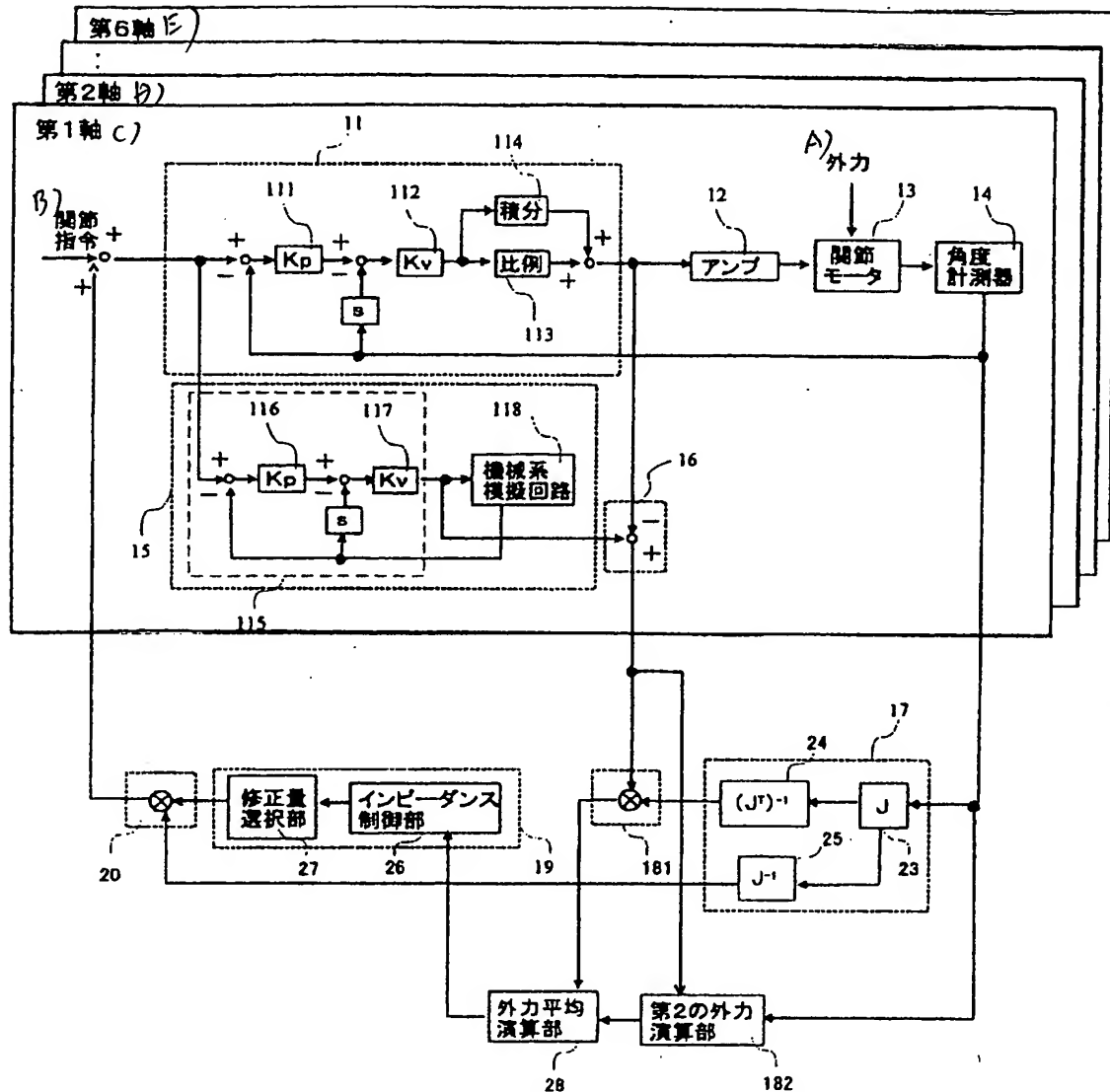


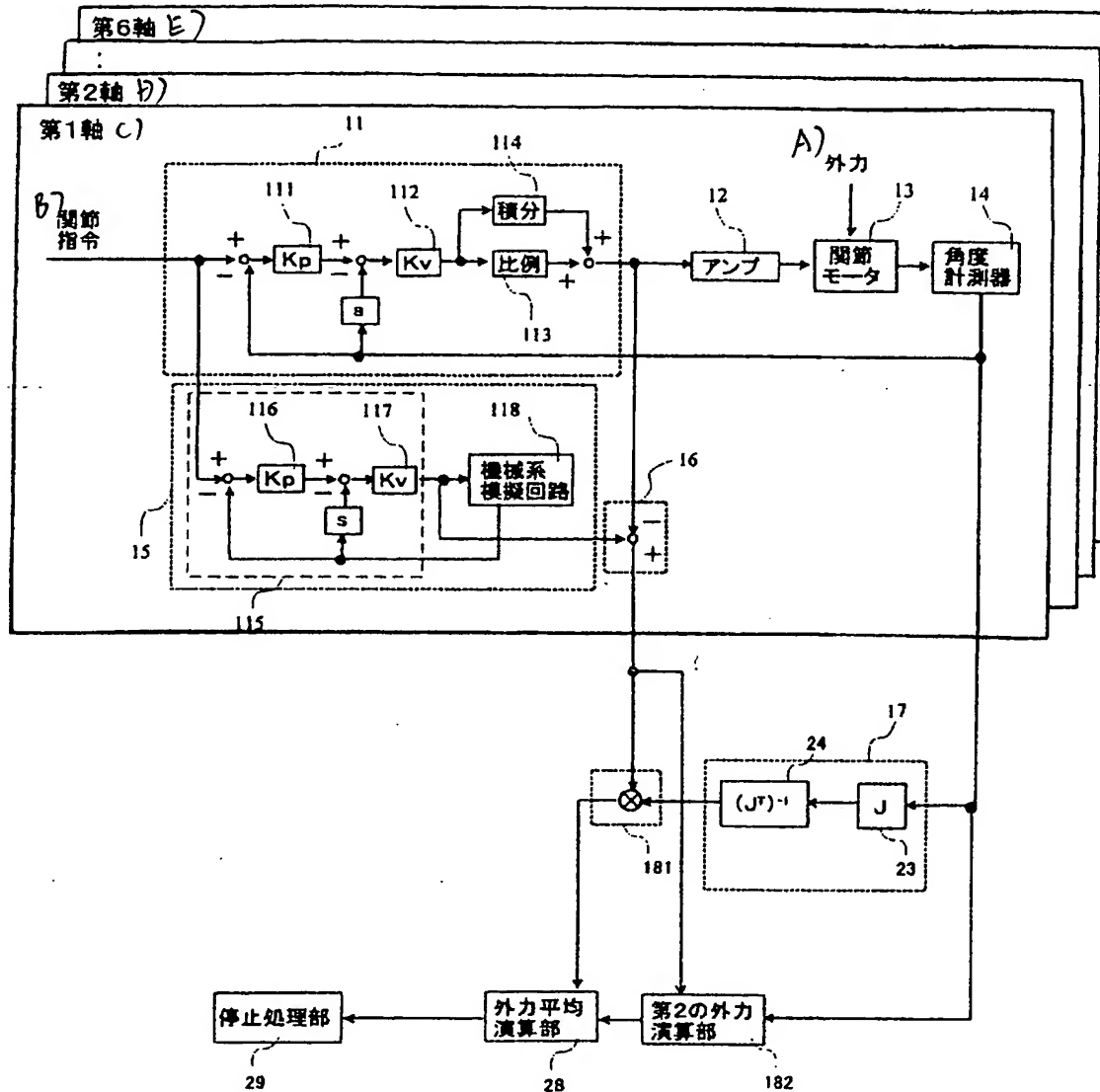
Fig. 4

Fig. 5



- A) External Force B) Joint Command C) First Axis
 D) Second Axis E) Sixth Axis
- (12) Amplifier (13) Joint Motor (14) Angle Measuring Device
 (26) Impedance Control Section
 (27) Correction Amount Selecting Section
 (28) External Force Average Calculating Section
 (113) Proportion (114) Integration
 (118) Mechanical System Imitating Circuit
 (182) Second External Force Calculating Section

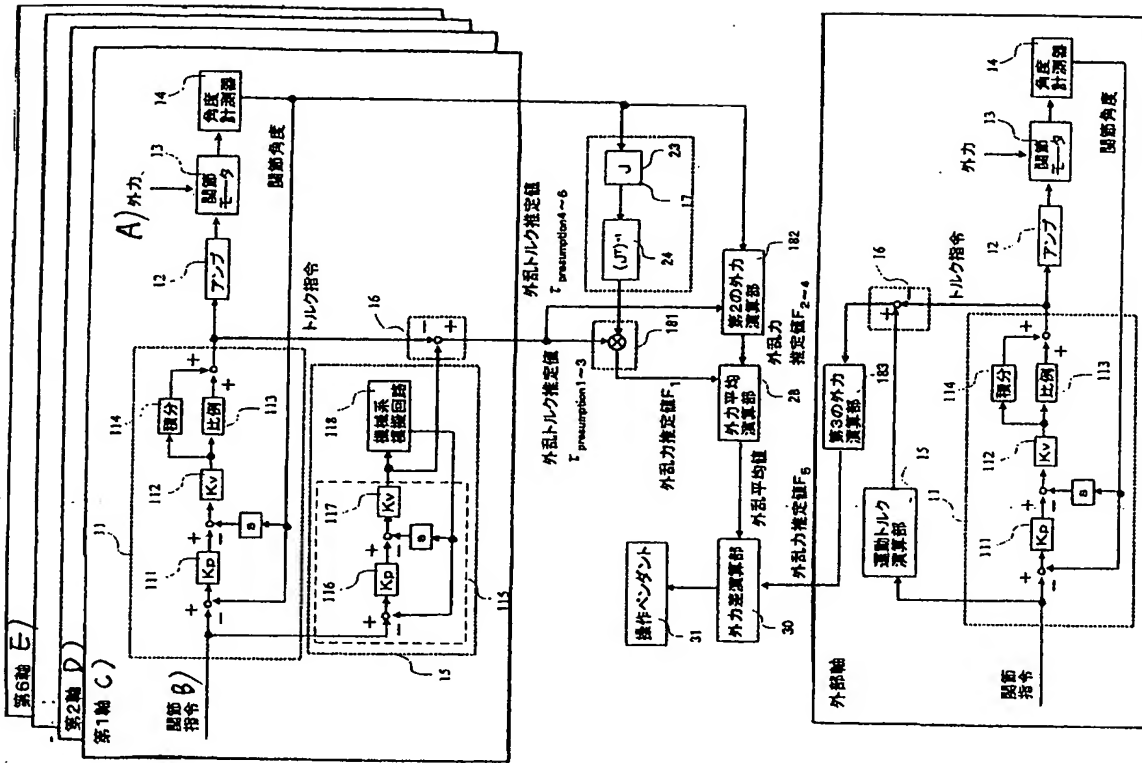
Fig. 6



- A) External Force B) Joint Command C) First Axis
 D) Second Axis E) Sixth Axis
- (12) Amplifier (13) Joint Motor (14) Angle Measuring Device
 (28) External Force Average Calculating Section
 (29) Stop Processing Section
 (113) Proportion (114) Integration
 (118) Mechanical System Imitating Circuit
 (182) Second External Force Calculating Section

Fig. 7

- A) External Force B) Joint Command
 C) First Axis D) Second Axis
 E) Sixth Axis
- (12) Amplifier (13) Joint Motor
 (14) Angle Measuring Device
 (28) External Force Average Calculating Section
 (30) External Force Difference Calculating Section
 (31) Operation Pendant
 (113) Proportion
 (114) Integration
 (118) Mechanical System Imitating Circuit
 (182) Second External Force Calculating Section
 (183) Third External Force Calculating Section
 (12) Amplifier
 (13) Joint Motor
 (14) Angle Measuring Device
 (15) Motion Torque Calculating Section



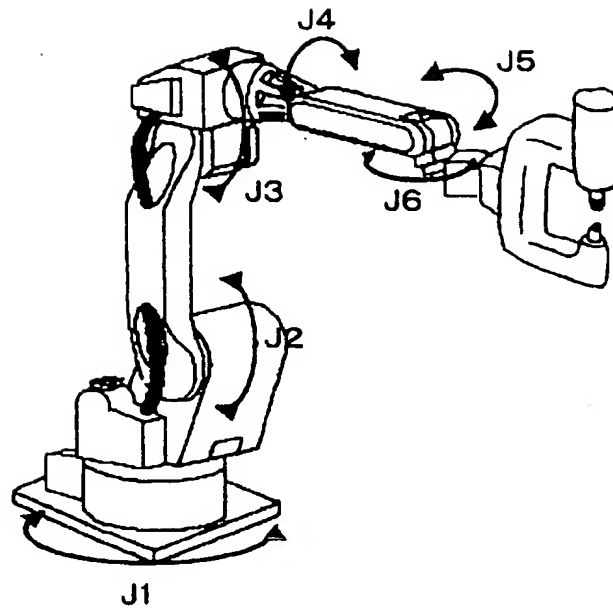


Fig. 8

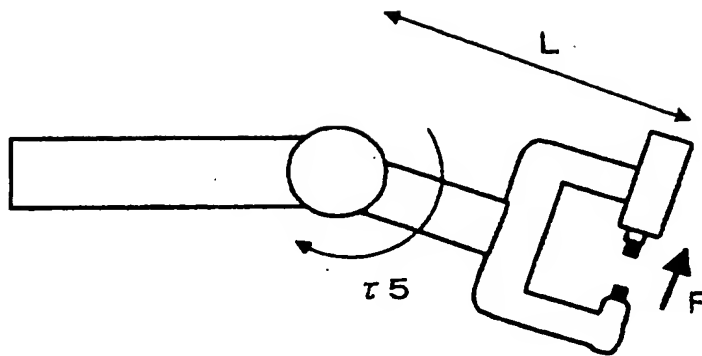


Fig. 9 (a)

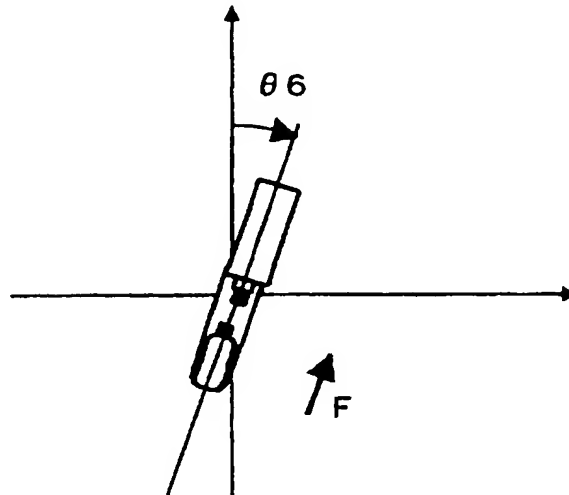
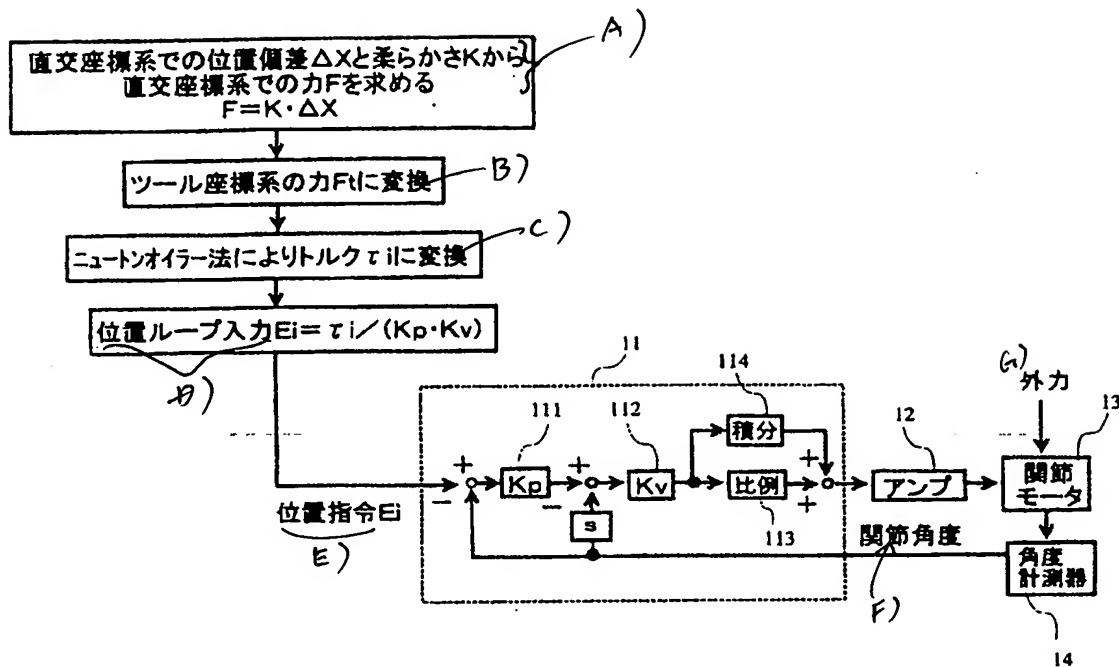


Fig. 9 (b)

Fig. 10



A) Obtain force F on Rectangular Coordinate System From Positional Deviation ΔX And Flexibility K

B) Convert to Force F_t on Tool Coordinate System

C) Convert to Torque τ_i by Newton Euler Method

D) Input A Position Loop

F) Position Command

F) Joint Angle

G) External Force

- (12) Amplifier
- (13) Joint Motor
- (14) Angle Measuring Device
- (113) Proportion
- (114) Integration